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NOTES ON GEOGRAPHIC DISTRIBUTION

New occurrences of the nonindigenous orange cup corals *Tubastraea coccinea* and *T. tagusensis* (Scleractinia: Dendrophylliidae) in Southwestern Atlantic

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ABSTRACT: The genus *Tubastraea*, with natural occurrence in the Pacific Ocean, was reported for the first time in Brazil along the coast of Rio de Janeiro. Since then it has also been reported in other sites along the south and southeast Brazilian coasts in oil platforms and rocky shores. We describe for the first time the occurrence of *Tubastraea tagusensis* and *T. coccinea* in the Northeastern coast of Brazil. The corals were found in the state of Bahia, sitting on shipwrecks, marina jetties as well as occupying space on a coral reef.

The genus *Tubastraea* Lesson, 1829 (Scleractinia: Dendrophylliidae), with natural occurrence in the Pacific Ocean, was reported for the first time in Brazil by Castro and Pires (2001) at the Campos Basin (offshore Brazilian Basin), north of Rio de Janeiro State, established in oil platforms (De Paula and Creed 2004), and since then it has also been reported on the coast of the states of Rio de Janeiro, São Paulo, Paraná, and Santa Catarina (De Paula and Creed 2005; Neves *et al.* 2006; Creed *et al.* 2008; Junqueira *et al.* 2009; Mantelatto *et al.* 2011; Silva and Barros 2011). It is now believed that these corals come to Brazilian waters fixed on oil platform structures and/or on large ship hulls (De Paula and Creed 2004).

The ahermatypic orange cup coral *Tubastraea* has an early reproductive age, where maturity is reached in about a year and a half (Fenner and Banks 2004). This feature, associated with the fact that it has an average growth of 3.02 cm^2/year (Vermeij 2005), a wide tolerance to variation in temperature, desiccation, and depth (De Paula and Creed 2005), and a great ecological tolerance body, explains its success as an efficient colonizer of new habitats (Vermeij 2005). The impact of exotic species, such as those of the genus *Tubastraea,* in remote areas has become a major threat, particularly to the reef environments, because the introduction of invasive species can be significantly deleterious to the integrity of the global marine biodiversity (Vitousek *et al.* 1997; Ferreira 2003; Sartoretto *et al.* 2008).

This paper describes, for the first time, the occurrence of the orange cup corals *Tubastraea tagusensis*, and *T. coccinea* in the northeastern coast of Brazil, and also describes the possible interactions among these coral species with endemic and endangered corals and reef fishes and the predation of the orange cup corals by the bearded worm *Hermodice carunculata* (Pallas, 1766) (Polychaeta, Amphinomidae). This new record of the genus *Tubastraea* expands its range by more than 2.000 km along the Brazilian coast.

The records were made in 2008, 2010 and 2011 during scuba diving in the Cavo Artemidi shipwreck, in 22 m deep (13°03'310" S, 38°31'551" W), the Marina Itaparica, 0,5 m deep (12°53.368'S, 38°41.070'W) and the Cascos coral reef, 12 m deep (13°7'27.10" S, 38°38'17.50" W), respectively. One of these sites are located inside Todos os Santos Bay (TSB), and the two latter is found at its entrance (Figure 1).

Material was collected by SCUBA divers. Samples of adult colonies of the sun corals were removed from the substrate at the base with a hammer and chisel. All marine species associated with the collected coral colonies

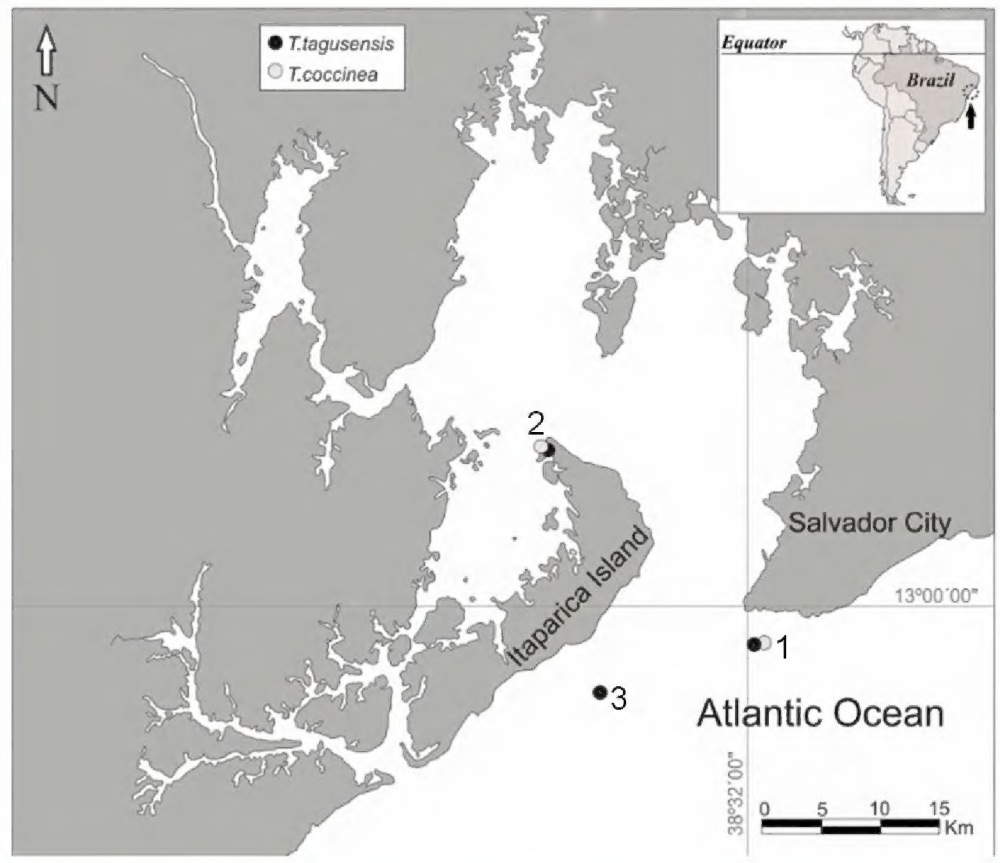

FIGURE 1. Distribution map of the orange cup corals, Tubastraea spp. in Bahia State. 1 Cavo Artemidi shipwreck; 2 Marina Itaparica, and 3 Cascos coral reef.

were identified visually with the aid of photographs and identification guides (Hetzel and Castro 1994; Humann and Deloach 2002; Sampaio and Nottingham 2008) and recorded on PVC plates.

The classification of the species *Tubastraea tagusensis* and *T. coccinea* (Figures 2a- b) was done in the laboratory and the voucher specimens were deposited in the Cnidaria Collection of the Museu de Zoologia from Universidade Federal da Bahia (UFBA). The recorded coral specimens were found at depths ranging between 0.5 and 22 m, being mostly located inside the wreckage, sheltered from direct sunlight and in areas with high hydrodynamics. These records agree with data available in the literature, except for the occurrence in the waters of Rio de Janeiro (De Paula and Creed 2004). These species seem to prefer shallow waters, avoiding low temperatures.

These associated fauna are the following: in the Cavo Artemidi shipwreck we recorded three morphotypes of ascidians, four of Porifera (Chondrillidae, Tethyidae and two Geodiidae), the Bryozoa Membraniporidae, the Brazilian endemic coral *Mussismilia hispida*, Verrill 1868, and three unidentified species of Cnidaria (Plumulariidae). All were located in areas around the colonies of the orange cup corals, with distances smaller than 50 cm, may probably competing for space with the corals. In the Marina Itaparica we recorded colonies of the octocoral *Carijoa riisei* (Duchassaing & Michelotti, 1860) in contact with *Tubastraea*, but we did not see any death signs on any of the species, different from that observed by Creed (2006), in rocky reefs at Ilha Grande Bay, southeastern Brazil.

Nine species of reef fishes were recorded closely associated with orange cup corals in the Cavo Artemidi shipwreck (Goldentail moray, *Gymnothorax miliaris* (Kaup, 1856); Green moray, *G.funebris* Ranzani, 1840; Spotted scorpionfish, *Scorpaena plumieri* Bloch, 1789; Greater soapfish, *Rypticus saponaceus* (Bloch and Schneider, 1801; Brazilian apogon, *Apogon americanus* Castelnau, 1855; Redspotted hawkfish, *Amblycirrhitus pinos* (Mowbray, 1927), Yellowtail damselfish, *Microspathodon chrysurus* (Cuvier, 1830) Damselfishes *Stegastes fuscus* (Cuvier, 1830) and *S. pictus* (Castelnau, 1855)), one endemic and endangered species, *Gramma brasiliensis* Sazima, Gasparini & Moura, 1998 (Figure 3) and one new to science, *Malacoctenus* sp. (Sampaio and Nottingham 2008)).

During one of our dives in the Cavo Artemidi shipwreck, we observed predation of three polyps of *Tubastraea tagusensis* by a single bearded fireworm *Hermodice carunculata* (Pallas, 1766) (Amphinomidae), which was seen engulfing the complete polyps of a colony of *T. tagusensis* (Figure 4). To date, this bristleworm (*Hermodice carunculata*) is the only known predator of *Tubastraea* in the Atlantic. It was recently recorded in the Cape Verde Islands (Wirtz and Debelius 2003). *Hermodice carunculata* is a common inhabitant of Brazilian reefs being a voracious predator that feeds on soft and hard corals, zoanthids, anemones, hydrocorals and dead fishes (Souza *et al.* 2007; Authors pers.obs.).

The presence of *Tubastraea* on coral reefs has not been previously reported in Brazil. In the Cascos reef these orange cup corals are dwelling with a low diverse coral fauna (Figura 5). During our investigation only five species of corals were registered: *Montastrea cavernosa* (Lyman 1859), *Siderastrea* sp. Blainville, 1830, *Madracis decactis*

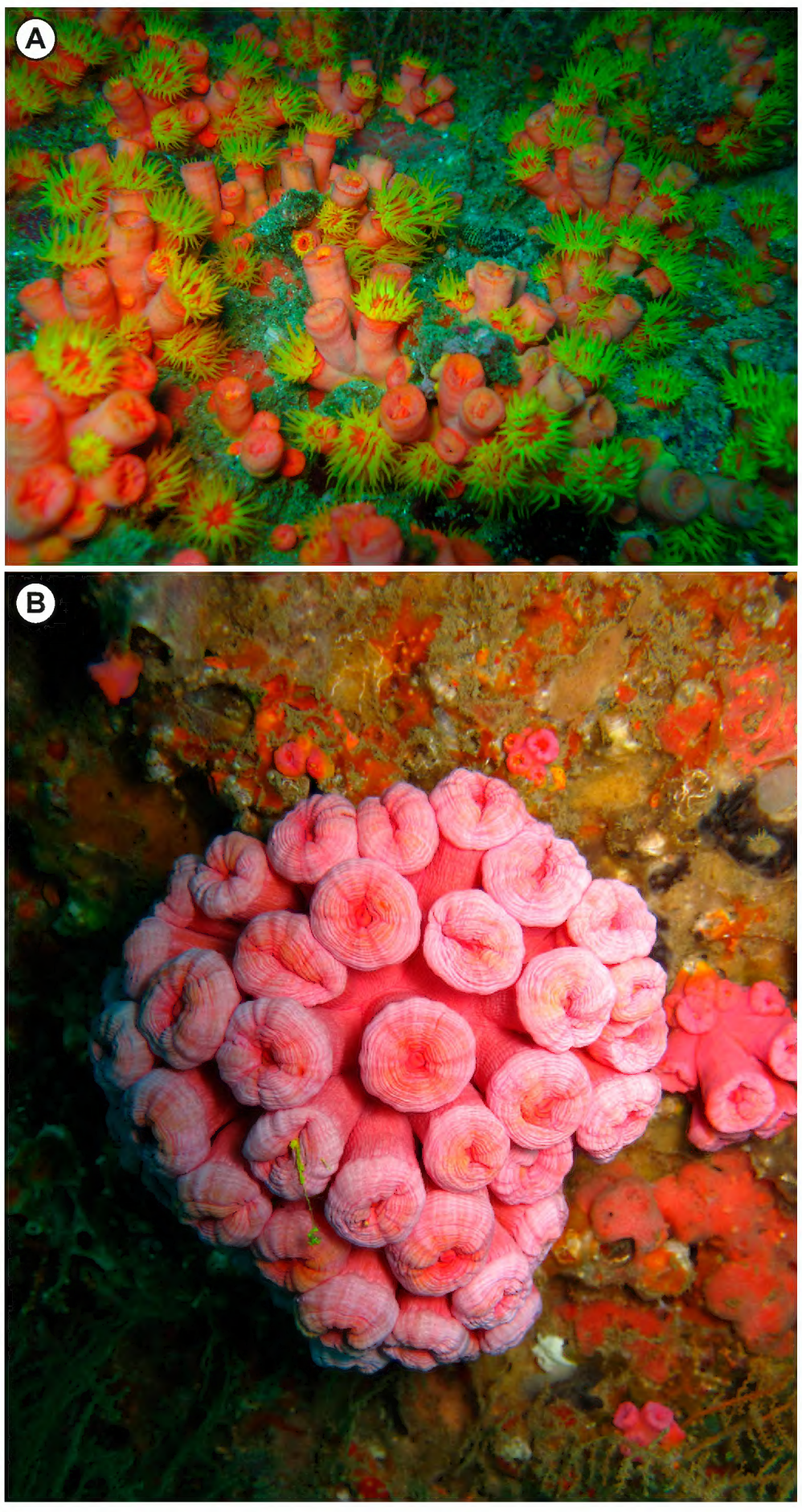

FIGURE 2. The orange cup corals: *Tubastraea tagusensis* (A) and *T. coccinea* (B) in the tropical coast of Brazil. Photos: C. L. S. Sampaio.

FIGURE 3. The orange cup coral, *Tubastraea tagusensis*, and the endemic and endangered Brazilian grama, *Gramma brasiliensis*, in Cavo Artemidi shipwreck, Bahia State. Photo: C. L. S. Sampaio.

Figure 4. Predation of a polyp of *Tubastraea tagusensis* by a bearded fireworm *Hermodice carunculata*, in Cavo Artemidi shipwreck, Bahia State. Photo: C. L. S. Sampaio.

Figure 5. The orange cup coral *Tubastraea tagusensis* in Cascos coral reef. Photo R. J. Miranda.

Lyman, 1859 and the endemic species *Favia lepthophylla*, Verrill, 1868 and *Mussismilia hispida*. All corals together cover approximately 20% of the reef substrate (R.J. Miranda, pers. obs.). Wood (1983) notes that *Tubastraea* species are generally absent from areas where other corals are abundant.

The TSB is the second largest bay in Brazil (Cirano and Lessa 2007) with a rich and endemic coral fauna (Castro and Pires 2001; Cruz *et al.* 2009), and is an area where there is an intense shipping traffic for crude oil transport, ore and many kinds of commodities to six different terminals and some hundred small fishing ports. The introduction of the orange cup corals into the bay waters may have occurred because of these ships or by the oil platforms which often enter TSB, and this may probably have favored the rapid increase in the distribution range of the coral infestation.

This new occurrence of *Tubastraea* in Brazilian waters increases its geographic distribution in the South Atlantic Ocean, and also confirms the great potential threat of the orange cup coral invasion to the coral reefs of Brazil. It urges the need to implant a coral reef monitoring program in the TSB, a significant site of coral reefs in the Southwestern Atlantic Ocean (Cruz *et al.* 2009).

Material examined: *Tubastraea coccinea*: Cavo Artemidi shipwreck, UFBA 715 and Marina Itaparica, UFBA716. *Tubastraea tagusensis*: Cavo Artemidi shipwreck, UFBA 713, Cascos reef, UFBA 714, and Marina Itaparica, UFBA 717.

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